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MAJOR CHEMICAL ACCIDENTS: ARE WE PREPARED?

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ISSUE DEFINITION

In the wake of the December 1984 release of methyl isocyanate at Bhopal, India, which killed at least 3,000 people and injured some 200,000, industry, governments and the public alike began to evaluate more seriously the status of emergency prevention, preparedness and response in Canada. It was not surprising to find that, with the increasing volume and diversity of chemicals being extracted, manufactured, marketed, transported, stored, or disposed of as waste, a substantial increase in the number of chemical accidents had been documented. In all likelihood, these increases implied greater probability of a major Canadian industrial accident equal to the Bhopal catastrophe.

Canada is an industrialized nation, both producing and utilizing hazardous chemicals and agents that, if released to the environment in an uncontrolled manner, could present a serious danger to health, life or the environment. To date, we have not experienced releases with acute effects on a large number of people. But perhaps, while we have responded appropriately to accidents, we have also been lucky. Only two persons died at the blowout of the sour-gas well at Lodgepole, Alberta in 1982, and no deaths occurred in the 1979 Mississauga railway accident that released a large cloud of deadly chlorine gas and required the evacuation of 216,000 people. More recently, the PCB fire at St-Basil-Le-Grand in July 1988, once again focused attention on the conditions responsible for, and the mechanisms capable of dealing with major industrial accidents. Are we prepared to respond to such an accident, and more importantly, do we have adequate mechanisms in place to minimize the likelihood of its occurrence?

In December 1984, in view of the accident in Bhopal, the Minister of the Environment instructed his Department to undertake an assessment of the adequacy of existing measures to prevent and respond to major industrial accidents in Canada. In March 1986, an industry-government working group tabled a report, "Bhopal Aftermath Review: An Assessment of the Canadian Situation," making 21 recommendations. If implemented, these should reduce the likelihood of major industrial accidents or mitigate their effects. These results can only be achieved by a concerted effort by all involved sectors, the public, the three levels of government and, most importantly, industry. This paper reviews the progress made for emergency prevention, preparedness, and response in Canada.

BACKGROUND AND ANALYSIS

A. The Potential for a Major Industrial Accident

The Bhopal Aftermath Working Group's analysis of the Canadian situation clearly indicated that the possibility of a major industrial accident of the Bhopal scale does exist in Canada. A major industrial accident, for the purposes of this paper, will be defined as an

> unplanned event which could occur during manufacturing, transportation, storage, use, handling or disposal of dangerous substances which may result in a release in such quantities so as to present a serious hazard to health, life, property or the environment beyond the limits of an installation or the right of way of the means of transportation.

Certain industrial sectors can be identified as primary producers of chemicals that could be involved in such a major industrial accident.

1. Major Industrial Sectors

The oil and gas production sector presents a risk predominantly in the drilling operation. At this stage of production, the unknowns are considerable compared with those in pipelines and gas plants where preventive measures can be better engineered and implemented. The

unexpected release of hydrogen sulphide (H_2S) in drilling a sour gas well poses the major chemical hazard. Exposure of any individual to high concentrations will result in death while exposure to even low concentrations can affect health. Evacuations are planned at a concentration below 15 parts per million (ppm). In the Lodgepole, Alberta, blowout a sour gas well emitted H_2S for 26 days before it was ignited, and the toxic hazard thereby reduced.

Petroleum refineries are located throughout the country with approximately 55% of the 1984 production in Quebec and Ontario, 12% in Alberta and 33% distributed between British Columbia, Saskatchewan and the Maritimes. Several refineries are located in urban areas, and present the potential for a major accident in the form of fire or explosions at the refinery itself or along its downstream distribution system. The release of H_2S from a refinery is also possible, but historically the Canadian refining industry has a good safety record with only isolated major accidents reported.

Chemical manufacturing plants are also located throughout Canada, although there is a particularly heavy concentration in the "Chemical Valley," Sarnia, Ontario and in the Fort Saskatchewan, Alberta area. Not only chemical manufacturers, but any large chemical users could be involved in a chemical accident and, since Bhopal, concern also includes the catastrophic potential involving user industries.

B. Prevention

1. Risk Assessment

Since it is recognized that in most cases little could be done to stop a major chemical release once it was in progress, logic suggests that mechanisms for prevention would be the most prudent avenue to follow. Risk assessment is an important initial step in prevention. In qualitative terms, risk assessment can be conducted by determining which substances have the greatest potential to affect the population ie., first by presenting a hazard such as toxicity or flammability, and second by having a high probability of being released or ignited. Preventive

measures can then be focused on these substances once they have been determined.

In Canada, two methods are available for determining high risk substances. A prospective approach could use the Regulations of the federal Transportation of Dangerous Goods Act which lists some 2,400 dangerous goods. In Schedule XII - Parts I and II, these are further refined to 300 chemicals that pose a risk and that could migrate well beyond the transportation corridor's right of way. In fact, response plans are required for these 300 chemicals, if they should be spilled in transit.

An examination of accident statistics can also indicate substances with an increased probability of risk. An analysis of the data from the National Analysis of Trends in Emergencies Systems (NATES) is a good example of such a retrospective approach. Environment Canada has since 1974 maintained these records, which indicate that approximately 3,000 large and small events are reported per year. Because reporting is not a statutory requirement, however, it is believed that this represents only 30% of the actual occurrences. Analysis of these statistics indicates that 150 chemicals make up 97% of the spill volume, which correlates well with the supply volume. Some chemicals could thus be targeted for preventive measures and quantitative risk assessments could be conducted, preferably on a site by site basis.

2. Adequacy of Reporting Accidents

The Transportation of Dangerous Goods Regulations require the submission of Dangerous Occurrence Reports which provide an extensive data base on transportation-related accidents. NATES compiles and analyzes information on spills from all sources but, because reporting is mandatory only in the transportation sector, there are gaps and inconsistencies of information on NATES and most other data bases. Furthermore, the data are not comprehensive enough to indicate the causes of the reported accidents, while near misses are not reported at all. Although industry might see reporting misses as providing the public with potentially alarming information, analysis of near misses could identify areas of concern, and correcting these could help prevent a future accident. For the above reasons the U.S. Science Advisory Board and the Canadian Bhopal Aftermath

Working Group believe that although short lists of Bhopal type chemicals may be useful in identifying high risk potential, such lists may give society a false sense of security. They therefore recommend that risk assessments should be conducted on a site-specific basis rather than by relying on short lists of identified chemicals.

NATES is not the only useful data base. In July 1987 the Transport of Dangerous Goods Directorate had identified 18 data bases in Canada related to dangerous goods accidents and spills. For example, in Ontario the Spills Action Centre, which collects information on spills under the Ontario Environmental Protection Act (1980), has documented 20,000 incidents since its inception. There has been discussion of establishing a central data base or clearing house for these and similar data bases, but to date there has been no action in this regard.

3. Legislation for Accident Prevention

While some may view legislation as conceptually punitive, its purpose is usually prevention. If there is compliance with the legislation and regulations, there should be fewer events of concern. In Canada, legislation relating to the chemical "life-cycle" (from chemical production, siting of plants and zoning, through plant design, construction and operation to transportation for distribution) largely parallels the hierarchy of government levels: municipal through provincial to federal. The three levels of government generally have a shared responsibility for controlling major industrial accidents, each with varying degrees of authority. (For a discussion of federal-provincial jurisdiction, see Current Issue Review, 88-11, Toxic Substances: Federal-Provincial Control).

As a rule, municipal governments are involved in setting by-laws governing the location of plants in order to provide adequate buffer zones between industrial complexes and residential areas. In Canada the municipalities are the creations of the provinces and their legislative authorities are granted under municipal acts and/or planning acts. They are thus given primary responsibility for local land-use planning. By insisting on adequate buffer zones the impacts of major industrial accidents could be mitigated.

Plant design and construction approval with regard to occupational health and safety and environmental concerns are predominantly within provincial jurisdiction, with some federal authority. Safety in industrial plants is an important consideration when chemical, petroleum and natural gas plants and related storage facilities are being designed and built, and when process operations are being planned. The training of workers in proper work procedures is an important feature of safety programs since workers can cause, or be responsible for avoiding, a major accident. Compliance with occupational safety and health regulations ensures a minimum standard for controlling the possibility of injuries to workers and establishes an acceptable attitude to safety in a plant. It is generally agreed that effective and safe plant operations over a long period can be achieved only when all risks are effectively controlled. Some of the specific considerations covered by current occupational health and safety regulations include entry to confined spaces, fire and explosion prevention; safety in piping systems; approval of plans, drawings and specifications for new buildings or alterations to existing buildings including industrial plants; handling of material; drilling, and drill stem testing for plant used in petroleum and natural gas production. There is a plethora of legislation in each province related to many of these issues.

Federal legislation mainly covers the transport sector of the industrial accident problem. This is because shipment of goods is often transboundary. Such legislation includes the Railway Act, Aeronautics Act, and the Canada Shipping Act, which are administered by the Canadian Transportation Commission and the Canadian Coast Guard. Under these acts, there are many regulations which apply to safety.

Starting around 1975, Transport Canada and other agencies began to look at the transportation of hazardous materials. On 10 November 1979, one of the worst Canadian derailment accidents took place in Mississauga, Ontario, resulting in the evacuation of some 216,000 people. This event launched a public enquiry and led to the federal government's acceleration of the development of legislation pertaining to the transport of hazardous materials. On 1 November 1980, the Transportation of Dangerous Goods Act (TDGA) was proclaimed. It applies with specific

exceptions, to all handling, offering for transport and actual carrying of dangerous goods through Canada, irrespective of the point of origin or destination or the means of conveyance. In July 1985, the first regulations under TDGA, applying to all modes of transportation, came into force. By means of federal-provincial agreements, each province has either adopted those of the federal government or developed its own equivalent regulations. Although the Act provides for in-transit storage the corresponding regulations have not yet been developed.

Of note is that the Mississauga accident would not have been prevented by any of these dangerous goods regulations because its cause was a malfunction of railway equipment. In this regard, many changes in the railway industry were implemented following the recommendations of the Grange Inquiry which examined the industry shortly after the Mississauga event. Some changes, such as emergency response plans, have been broadly applied while others have been effected in particular municipalities, e.g. speed restrictions in Edmonton and Toronto. Safety in the rail industry is particularly important since 70% of the amount of goods regulated by TDGA is moved by rail and the volumes of chemicals released due to rail accidents are proportionally higher than rail's percentage (10%) of the number of releases for all types of transportation. This is because rail cars generally carry larger quantities than do other modes of transport such as trucks.

Every province has some legislative provision that requires reporting of accidents or spills. There is, however, little consistency from province to province and in some cases the regulations of the legislation have not been prepared or they cover only specific substances. At the federal level the new Canadian Environmental Protection Act (CEPA) can require reporting for those toxic substances listed in its Schedule I. To date, however, there are only nine substances in Schedule I, and the regulations dealing with these substances are the same as they were before previous legislation was rolled over into CEPA.

In effect, industry has a well established control over its own operations and properties and does not openly welcome additional regulation and legislation, believing it is and should continue to be responsible for itself and to the community. With regard to acute problems

from major industrial accidents, Canadian industry does display a good track record. With regard to the chronic, environmental problems of chemical discharges and emissions, however, its medals are often viewed as tarnished; so much so that environmental advocates believe that monitoring and reporting should be mandatory in any effective regulatory system. Many maintain that while legislation is not a guarantee that accidents will be reported, a lack of legislation is a guarantee that they will not be.

4. Corporate Preventive Measures

In Canada, legislation defines the employer's responsibility for safety. Many companies have consequently communicated their commitment to safety through individual safety programs. These programs generally start with a policy statement indicating clearly that the objective of the company is the total elimination of accidents, injuries, or losses to the employees, the company, the public and the environment. The Canadian Chemical Producers' Association (CCPA) is an umbrella organization representing the major chemical manufacturers in Canada. In order to become a member of CCPA each chemical producing company must recognize, sign and abide by a policy of "Responsible Care." As in any sector, such a policy, however, will accomplish little unless it is converted into specific activities.

Perhaps one of the most effective methods of ensuring that internal company practices will minimize the potential for accidents is safety auditing. Safety audits evaluate the adequacy of a company's safety program, and may be completed internally or by an outside consultant or insuring agent. Although variable, depending on their objective, standardized methods for safety audits have been developed. For example, the Industrial Accident Prevention Association of Ontario makes available its "5 Star Safety Audit Program" to interested parties.

C. Response Mechanisms

An examination of our overall accident preparedness indicates that response programs have traditionally been emphasized more than prevention programs. There is no doubt of the necessity for good

response programs, since they may assist in reducing the impact of a major industrial accident. The magnitude of a Bhopal-type incident is so great, however, and the events can develop so quickly, that the primary effort must be in prevention. Although technology in response capabilities is advancing rapidly, it is still severely limited.

The level of government most immediately and directly affected by a major toxic chemical release in an urban area would be the municipal government. It has primary responsibility for an initial response through elected officials, fire, police and other emergency services. They would assess the danger, protect threatened populations, take steps to contain or mitigate the problem where it was safe to do so (e.g. fight fire, use water spray barrier or foam), control crowds and traffic, and take command of the response operation for public safety. As results of an accident escalate, the command of operations may shift from the municipal government to the provincial, although such transfer would occur only in unusual circumstances such as a Bhopal-type incident.

Other local agencies and services that would be involved in major chemical incidents include emergency medical clinics, hospitals, poison control centres, public works and social services for emergency accommodation, clothing and feeding. The coordination of the work of all these agencies would require municipal-level contingency plans.

1. Contingency Planning

In approximately half of the provinces, emergency response planning is left to the discretion of the municipalities with only minimal guidance from provincial or federal agencies. Partly because of resource limitations, many municipalities, particularly small ones, are not in a position to deal with incidents involving hazardous materials. Emergency Preparedness Canada (EPC), an autonomous agency of the Public Service since passage of the Emergency Preparedness Act in October 1988, is in the final throes of preparing a publication outlining guidelines for municipalities planning for emergencies. This will replace its publication entitled "A Guide to Civil Emergency Planning for Municipalities" and will cover multi-hazard incidents including those involving hazardous materials. EPC

will continue to shift its emphasis to peace-time emergency preparedness (80% of its mandate) from preparedness for wartime emergencies.

Major chemical producers, the petroleum industry, the steel industry and major railways have been developing contingency plans for many years. As might be expected, it is the larger industries which have developed the more sophisticated programs, often in conjunction with the community and municipality. In particular, in the two areas of Canada where there is concentration of chemical and petroleum facilities (Sarnia, Ontario and Fort Saskatchewan, Alberta) elaborate, integrated plans are in effect. In Sarnia, the Chemical Valley Emergency Control Organization (CVECO) has been tested over the years by regular simulations, revised and updated as needed. Fort Saskatchewan's mutual aid system (FORT MAP) has a constitution, and maintains funds and equipment not possessed by individual members. CVECO and FORT MAP incorporate a multitude of appropriate sectors: industry, fire departments, police, ambulance and hospital services and the relevant transportation sectors. There is, however, a need for a transfer of information and knowledge to smaller industries. In this regard, the Canadian Manufacturers' Association expects to release its 40-page handbook for small industries in April 1989, while CCPA is due to release guidelines for large industries at the same time.

In the field of emergency response to chemical transportation incidents, CCPA has had a Transportation Emergency Assistance Plan (TEAP) since 1971. TEAP was the first national system established in North America to offer technical advice at the scene of transportation emergencies while companies provided emergency response teams when they were requested. Early in 1983 TEAP was modified to become an emergency response organization. TEAP's information role has consequently been assumed by CANUTEC, the Canadian Transport Emergency Centre, located in Ottawa as part of Transport Canada. CANUTEC provides immediate advice and scientific data by telephone to those who respond to emergencies such as a fire, spill or leak involving dangerous goods. The service is available 24 hours a day, 7 days a week by dialling collect (613) 996-6666. TEAP and CANUTEC are therefore viewed as complementary. Approximately 25% of the companies in Canada producing chemicals are not

members of CCPA or have not entered into mutual aid agreements with CCPA and are therefore not participants in TEAP. Under the TDGA, however, they are required to file a summary of contingency plans with Transport Canada. Once again it can be seen how transportation is the most comprehensively prepared-for stage of the life-cycle of chemical management.

It has been questioned whether it is time for national legislation in Canada for mandatory contingency plans, similar to the federal legislation in the United States known as SARA Title III, the Emergency Planning and Community Right-to-Know Act (1986), a free standing statute included in the Superfund Amendments and Reauthorization Act (SARA) of 1986. SARA Title III mandates local and state governments to create organizations whose sole responsibility is to develop emergency response plans. Additionally this powerful statute requires industries with more than ten employees to report annually any releases of toxic chemicals and to provide information to the communities on the existence and quantities of chemicals in the facilities.

2. Buffer Zones

Community land-use planning helps to minimize the impact of a major industrial disaster. Unfortunately, communities have grown up around industrial sites in many areas of Canada. In these locations buffer zones are usually minimal, eliminating one of the major response mechanisms that can reduce the effect of a major industrial accident.

Recommendations with regard to the buffer zones in Canada were made by a working group of the Major Industrial Accidents Coordinating Committee (MIACC) in 1988 (MIACC is discussed in more detail in the next section). The intent of these recommendations is to help establish guidelines for zoning regulations for Canadian municipalities creating buffer zones. The recommendations are as follows:

1. Buffer zones should be considered, not only for industrial chemical complexes but also for transport corridors through which dangerous goods pass.

2. Provinces should introduce legislation directing municipalities to establish buffer zones around dangerous goods facilities and transport corridors, and should increase their efforts to assist municipalities

in siting new installations, including new transportation corridors.

3. Provinces should establish general guidelines with respect to buffer zones to assist municipalities in establishing zoning regulations.

4. Municipalities should work closely with industry and should avail themselves of industry expertise, especially in the area of disaster modelling, in designating set back distances.

5. Municipalities should establish guidelines for land use in areas proximate to dangerous goods facilities and transport corridors.

6. Industry should work closely with municipalities to inform the public of the nature of the danger presented by dangerous goods.

Additionally, this working group believes that there is a need to establish a set of national guidelines for the establishment of buffer zones and compatible options for land use within them. At present, decisions regarding buffer zones are subjective, and some standardization, even at a provincial level would reduce the likelihood of "havens" (municipalities with fewer requirements which might induce industry to locate there). It appears the only province with any buffer zone regulation is Alberta, and that regulation is relevant only to sour gas facilities and residences.

D. Coordination of Emergency Preparedness (MIACC)

One general recommendation of the Bhopal Aftermath Review report was the establishment of a coordinating task force, comprising senior level officials from appropriate government departments, representatives of industry and other interested parties, to evaluate the implications of the report recommendations. Additionally, it was suggested that the task force could coordinate or monitor activities undertaken in emergency preparedness and report on the progress achieved. When the report was released, the Minister responsible for the Environment Department and Emergency Preparedness Canada, and the President of the CCPA indicated their intention to establish such a coordinating body. A series

of meetings resulted in the establishment of the Major Industrial Accidents Coordinating Committee (MIACC). The first MIACC conference was held in Ottawa in September 1987 and was attended by more than 70 persons from across Canada. A Steering Committee and Secretariat was formed to coordinate the establishment and research of working groups addressing the status in Canada of all the topics covered in this paper. MIACC's second conference was held in November 1988, with twice the number of participants. Working groups reported the results of their studies, made recommendations, and suggested future ways in which MIACC could maximize its usefulness (including prevention and response) in improving Canada's preparedness to deal with major industrial accidents. Some of their recommendations have been summarized in this report.

Support for MIACC is strong among all stakeholders except environmental non-government organizations (ENGOS). (ENGOS believe MIACC to be commendable in its own right but feel the perspective is narrow and that the chronic release of chemical pollutants is a more serious concern.) Autonomous regional MIACC groups are also being formed. A provincial Alberta MIACC has already held meetings, and the Quebec cabinet has decided that such an organization will be formed in that province. The MIACC Steering Committee will shortly be determining future directions.

PARLIAMENTARY ACTION

November 1980 - Transportation of Dangerous Goods Act was proclaimed one year after the chlorine gas release in Mississauga, Ontario.

December 1984 - Minister of Environment requested a review of emergency preparedness in Canada to deal with Bhopal-like accidents.

June 1988 - The Canadian Environmental Protection Act (CEPA) was proclaimed in force. This has provisions that, if addressed through regulations, could reduce the potential for a major accident involving specific chemicals.

September 1988 - An interim order regarding conditions for the storage of wastes containing PCBs was made under s. 35(1) of CEPA.

October 1988 - Emergency Preparedness Act was proclaimed, which created Emergency Preparedness Canada as an autonomous agency, whose mandate would focus on peacetime emergency preparedness.

CHRONOLOGY

November 1979 - A train derailment in Mississauga, Ontario, released toxic chlorine gas and necessitated the evacuation of 216,000 people.

October 1982 - A blow-out of a sour gas well in Lodgepole, Alberta, released toxic hydrogen sulphide for 26 days. Two persons were killed.

February 1984 - An explosion of a gasoline pipeline took place in Sao Paulo, Brazil; 500 people were killed.

December 1984 - A release of toxic methylisocyanate at Bhopal, India, killed 3,000 people and seriously impaired the health of at least 200,000 more.

March 1986 - The report "Bhopal Aftermath Review: An Assessment of the Canadian Situation" was released, indicating that a Bhopal-like accident could occur in Canada.

November 1986 - A fire in a chemical warehouse near Basel, Switzerland, discharged 6 to 20 tonnes of toxic chemicals and metals into the Rhine River, causing massive killing of benthic organisms and fish.

November 1987 - First annual meeting of the Major Industrial Accident Co-ordinating Committee (MIACC), a multi-stakeholder group to facilitate emergency preparedness in Canada.

July 1988 - A fire in PCB-waste storage site in St-Basil-Le-Grand, forced the evacuation of 3,300 people. Expected costs for emergency response and reimbursement of evacuees ranges from $20 million to $50 million. Lawsuits are pending.

November 1987 - First annual meeting of the Major Industrial Accident Co-ordinating Committee (MIACC), a multi-stakeholder group to facilitate emergency preparedness in Canada.

August 1988 - A fire in PCB-waste storage site in St-Basil-Le-Grand, forced the evacuation of 5,300 people. Expected costs for emergency response and reimbursement of evacuees range from $35 million to $40 million. Lawsuits are pending.

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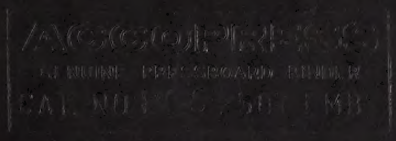

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